PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



EXAM QUESTION PACK

SECTION 4: ECOLOGY AND THE ENVIRONMENT (PACK 3)

SCORE	PERCENTAGE
/209	%

STEMUP

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Q1.

The diagram shows a male fruit fly with long wings and a female fruit fly with long wings.



male female

Wing length in these flies is controlled by a gene with two alleles.

The dominant allele (L) produces long wings and the recessive allele (l) produces short wings.

A male and a female fruit fly mate.

The table shows the number of male and female offspring with long wings and short wings.

Phenotype	Number of offspring
male with long wings	38
male with short wings	10
female with long wings	36
female with short wings	15

(a) Which of these describes the genotypes of the parent fruit flies?

(1)

☒ **A** both are heterozygous

☒ **B** both are homozygous

☒ **C** both have long wings

☒ **D** one is heterozygous and one is homozygous

(b) (i) Genetic diagrams are used to show how sex is inherited.

Complete the genetic diagram to show that equal numbers of male and female offspring are produced.

(2)

	X	Y

(ii) Explain why the results of the cross might not produce exactly equal numbers of male and female offspring.

(2)

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(c) Fruit flies feed on decomposing fruit.

The smell of the fruit attracts the fruit flies.

Design an investigation to find out if the smell of decomposing apples attracts fruit flies more than the smell of decomposing bananas.

Include experimental details in your answer and write in full sentences.

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(Total for question = 11 marks)

Q2.

Farmers can increase their crop yield by growing crops in a temperature controlled glasshouse.

(a) (i) Explain how increasing the temperature can result in an increase in crop yield.

(2)

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(ii) Farmers sometimes use a type of heater that burns gas or oil to raise the temperature of their glasshouse to improve crop yield.

Explain why they use this type of heater to improve crop yield.

(2)

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(b) Some farmers also add chemical fertilisers to their crops in a glasshouse.

(i) Different minerals are added to chemical fertilisers. Explain one mineral that should be added to these fertilisers.

(2)

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(ii) Discuss why some farmers limit the amount of chemical fertilisers they add to their crops.

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(Total for question = 11 marks)

Q3.

Pollution of air or water can affect ecosystems.

(a) (i) Explain the biological consequences of air pollution by sulfur dioxide.

(3)

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(ii) State how sulfur dioxide pollution can be reduced.

(1)

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(b) Some scientists have suggested that adding hydrogencarbonate solution to soil, instead of adding water, can increase plant growth.

Design an investigation to discover the effect that adding hydrogencarbonate solution has on the growth of seedlings.

Include experimental details in your answer and write in full sentences.

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(Total for question = 10 marks)

Q4.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Many farmers keep their chickens in sheds.

They claim that their chickens grow larger when kept in sheds rather than outside in fields.

(a) Design an investigation to test this claim.

Your answer should include experimental details and be written in full sentences.

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(b) Which of these is used to test for protein in chicken meat?

(1)

☒ **A** Benedict's reagent

☒ **B** biuret reagent

☒ **C** ethanol

☒ **D** iodine

(c) Suggest why the respiration rate of a small chicken is higher than the respiration rate of a large chicken.

(4)

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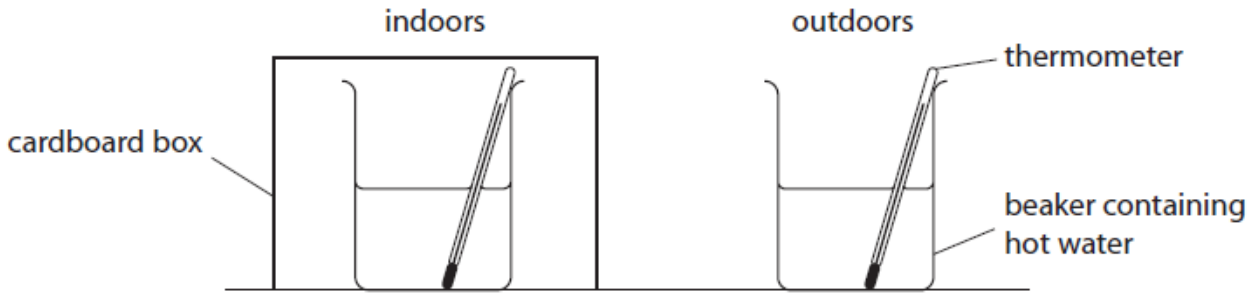
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Q5.

Farmers can keep their animals indoors or outdoors.

A student uses this apparatus to compare the heat loss from animals kept indoors and outdoors.

He uses a covered beaker to represent animals indoors and an uncovered beaker to represent animals outdoors.



This is the student's method.

- pour 200 cm^3 of hot water into each beaker
- measure the temperature of the water in each beaker
- cover one beaker with a cardboard box
- measure the temperature of the water in each beaker after 30 minutes

The student repeats the investigation six times and calculates the mean temperature of the water for each beaker.

The table shows the student's results.

Time in minutes	Mean temperature of water in °C	
	uncovered	covered
0	80	80
30	40	44

(a) Give the dependent variable in this investigation.

(1)

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(b) Give one reason why the student uses the same volume of water in each beaker.

(1)

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(c) Calculate the difference between the percentage decrease in temperature for the uncovered beaker and the percentage decrease in temperature for the covered beaker.

(2)

difference = ... %

(d) The student concludes that it is better for farmers to keep their animals indoors.

Discuss this conclusion.

(4)

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(e) Describe how the student could modify his investigation to find out if an animal's body size affects heat loss.

(2)

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(Total for question = 10 marks)

Q6.

Lichens are organisms that grow well on stone walls in unpolluted air.

Lichens grow less well in polluted air.

Car exhaust fumes contain sulfur dioxide that pollutes air.

A scientist investigates the effect of pollution by cars in a city.

This is her method.

- measure the percentage area of a stone wall in the city centre covered by lichen
- repeat this measurement at different distances from the city centre

The table shows her results.

Distance from city centre in km	Percentage area covered by lichen (%)
0	0
2	6
4	20
6	30
8	50
10	64
12	70

(a) Explain the results shown in the table.

(2)

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(b) Describe a method to measure the percentage of a stone wall covered by lichen.

(3)

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(c) Adding water to a powder called sodium metabisulphite will release sulfur dioxide gas.

Devise a laboratory investigation to find out the effect of sulfur dioxide gas on the heat released by germinating seeds.

Include experimental details in your answer and write in full sentences.

(6)

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(Total for question = 11 marks)

Q7.

A student studies the organisms in a pond community.

(a) Which of these is the correct description of a community?

(1)

☒ **A** the living organisms together with their non-living environment

☒ **B** the area where organisms live

☒ **C** the organisms of all species in a habitat

☒ **D** the organisms of one species in a habitat

(b) The table shows the number of organisms per m^2 at different trophic levels in a pond community.

It also shows the total biomass of these organisms per m^2.

Trophic level	Number of individuals per m^2	Total biomass in g per m^2
secondary consumers	100	1.0
primary consumers	1.5×10^4	2.5
producers	7.2×10^{10}	17.5

(i) Calculate the mean mass in g of a single primary consumer.

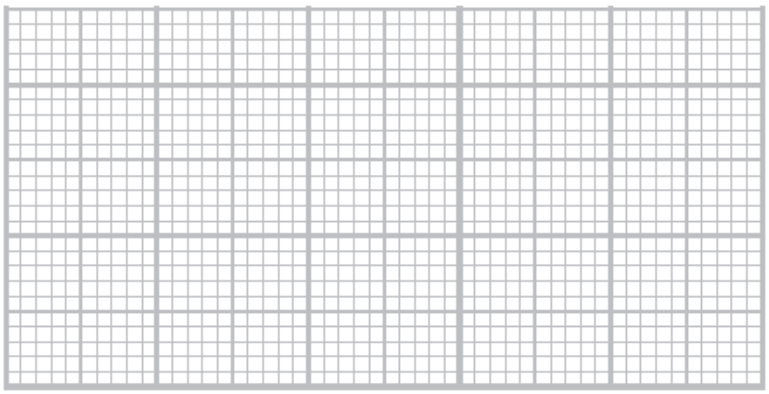
Give your answer in standard form.

(3)

mean mass = ... g

(ii) Use the grid to draw a pyramid of biomass for the pond community.

(2)



(c) The number of secondary consumers is low because energy transfer is not 100% efficient.

(i) Explain why egestion is one reason why energy transfer is not 100% efficient.

(2)

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(ii) Give two other reasons why energy transfer is not 100% efficient.

(2)

1 .....

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2 .....

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(Total for question = 10 marks)

Q8.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Plants use photosynthesis for nutrition.

(a) What is the term used for plants at the beginning of food chains?

(1)

☒ **A** decomposers

☒ **B** primary consumers

☒ **C** producers

☒ **D** secondary consumers

(b) Which of these is the balanced chemical equation for photosynthesis?

(1)

☒ **A** $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

☒ **B** $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

☒ **C** $6CO_2 + 6H_2O \rightarrow C6H_{12}O_6 + 6O_2$

☒ **D** $C_6H_{12}O \rightarrow 2C_3H_6O_3$

(c) A student uses this method to demonstrate that light is required for photosynthesis.

Step 1 Put two potted plants in a dark cupboard for 24 hours.

Step 2 Take one plant out of the cupboard and place it in sunlight for 24 hours but keep the other plant in the dark cupboard.

Step 3 Remove a leaf from the plant in the sunlight.

Step 4 Place the leaf in boiling water for 30 seconds.

Step 5 Put the leaf in a boiling tube containing hot ethanol for 15 minutes.

Step 6 Wash the leaf in cold water and place it on a white tile.

Step 7 Add iodine solution to cover the leaf and observe any changes in the colour of the leaf.

Repeat steps 4 to 7 for a leaf removed from the plant that was kept in the dark cupboard.

(i) Explain why the student put the plants in a dark cupboard for 24 hours in step 1.

(2)

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(ii) Describe how the student could heat ethanol safely in step 5.

(2)

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(iii) State the colour change for each of the leaves tested in step 7.

(1)

Leaf in sunlight

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Leaf in the dark

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(Total for question = 7 marks)

Q9.

In some countries, snails are farmed as a source of protein.

The photograph shows a snail.



(Source: © PAL/Shutterstock)

(a) A scientist investigates the effect of temperature on the growth of snails.

The scientist measures the mean (average) shell height of groups of snails kept at three different temperatures for 24 weeks.

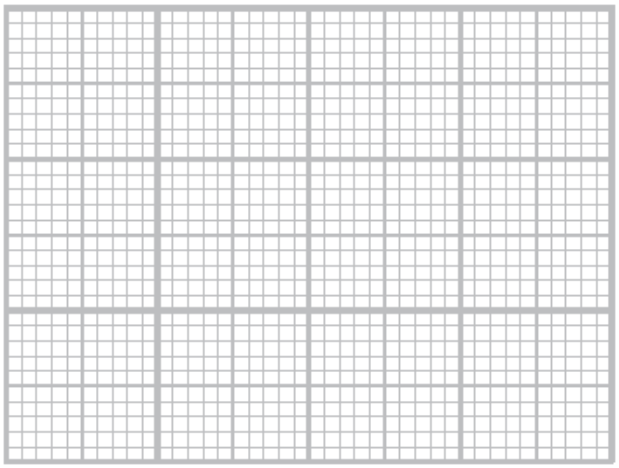
The table shows the scientist's results.

Time in weeks	Mean shell height in mm		
	at 8 °C	at 15 °C	at 23 °C
0	15.0	15.0	15.0
8	15.2	15.8	17.0
16	15.5	16.8	20.4
24	16.4	18.2	21.8

(i) Plot a line graph to show how the mean shell height increases with time for each temperature.

Use a ruler to join the points with straight lines.

(5)



(ii) Explain the effect of temperature on the growth of snails in this investigation.

(3)

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(iii) State the dependent variable in the investigation.

(1)

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(iv) State how the scientist made sure their results were reliable.

(1)

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(b) Assimilation efficiency is the percentage of food that is eaten and not egested as faeces.

Assimilation efficiency is calculated using this formula.

$$\text{assimilation efficiency (\%)} = \frac{\text{mass of food eaten} - \text{mass of faeces egested}}{\text{mass of food eaten}} \times 100$$

(i) A snail eats 1.2 g of food and produces 0.30 g of faeces.

Calculate the assimilation efficiency of this snail.

(2)

assimilation efficiency = ... %

(ii) Explain why the assimilation efficiency of a primary consumer is less than the assimilation efficiency of a secondary consumer.

(2)

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(c) The production efficiency of an animal is the percentage of assimilated food that is made into new biomass.

The table shows the production efficiency of a mammal and a snail, both of which are primary consumers.

Animal	Production efficiency (%)
mammal	2
snail	35

Suggest why there is a difference in the production efficiency of the mammal and the snail.

(2)

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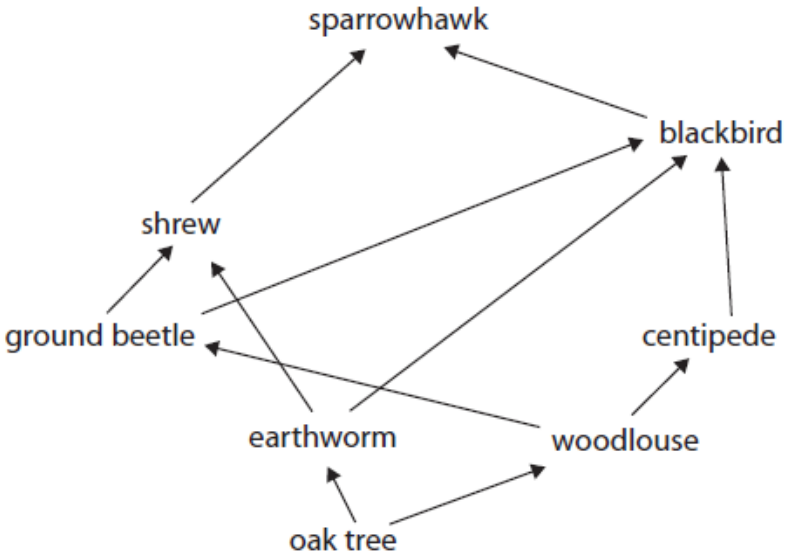
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(Total for question = 16 marks)

Q10.

The diagram shows a food web from a woodland ecosystem.



(a) (i) Which organism in the food web is the producer?

(1)

☒ **A** blackbird

☒ **B** centipede

☒ **C** earthworm

☒ **D** oak tree

(ii) Which organism acts as both a secondary consumer and a tertiary consumer in the food web?

(1)

☒ **A** blackbird

☒ **B** earthworm

☒ **C** ground beetle

☒ **D** sparrowhawk

(b) The amount of energy transferred changes as you move along a food chain.

The data comes from an ecosystem containing producers, primary consumers and secondary consumers.

Level	Energy in each level in kJ per m^2 per year
producers	8.7×10^5
primary consumers	1.4×10^4
secondary consumers	1.6×10^3

(i) The light energy reaching the producers is 7.1×10^6 kJ per m^2 per year.

Explain why the plants cannot absorb all of this energy.

(2)

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(ii) The table shows that energy is transferred between producer and primary consumer and between primary consumer and secondary consumer.

A student states that the energy transfer between producer and primary consumer is the most efficient.

Determine whether the student's statement is correct.

(2)

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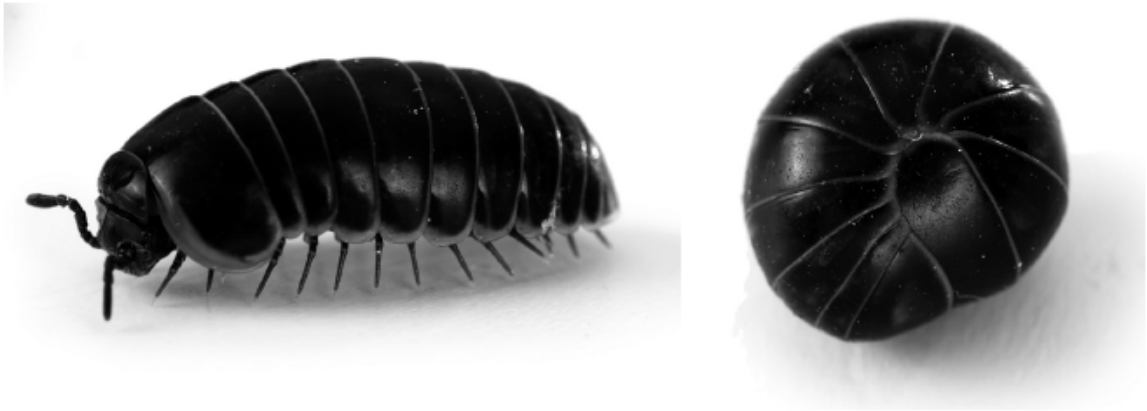
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(c) Woodlice feed on dead and decaying plant material in the soil.
The photographs show how a woodlouse can curl up into a ball.

This behaviour is an example of a reflex response.



(Source: © StellaNature Alamy Stock Photo)

(i) State what is meant by a reflex response.

(1)

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(ii) Give a reason why this reflex response benefits the woodlouse.

(1)

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(iii) Describe how this reflex response could have evolved by natural selection.

(4)

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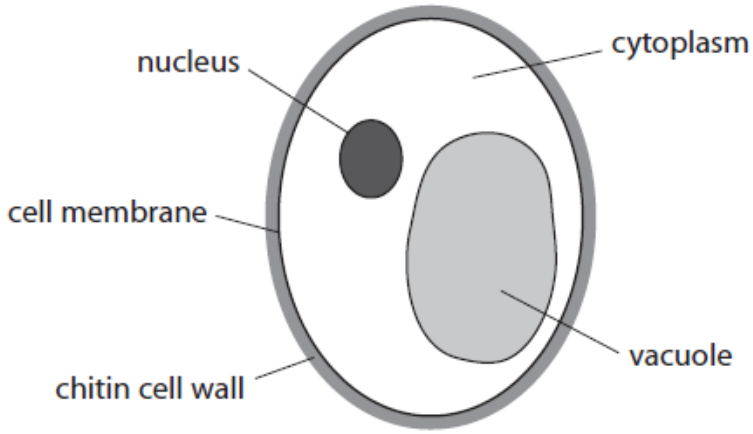
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(Total for question = 12 marks)

Q11.

Yeast is used to make bread.

The diagram shows a yeast cell.



(a) Give two differences between the structure of a yeast cell and the structure of a plant leaf cell.

(2)

1 .....

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2 .....

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(b) A student uses this method to investigate the effect of oxygen on the growth of yeast.

- put 100 cm^3 of glucose solution into each of two beakers
- add 0.1 g of yeast to each beaker
- bubble sterile oxygen into one beaker and sterile nitrogen into the other beaker
- after 24 hours, take three samples from each beaker
- observe these samples using a microscope
- count the number of yeast cells in one field of view for each sample

The table shows the student's results.

Sample	Number of yeast cells	
	glucose solution with oxygen	glucose solution with nitrogen
1	20	17
2	25	14
3	22	11

(i) Explain the student's results.

(2)

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(ii) The oxygen and nitrogen are sterilised to remove micro-organisms.

Suggest why micro-organisms need to be removed from these gases.

(2)

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(iii) The student controls these variables in his investigation.

- the volume of glucose solution
- the mass of yeast
- the time of sampling

Give three other variables he needs to control.

(3)

1 .....

2 .....

3 .....

(iv) Comment on the reliability of the student's data.

(1)

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(Total for question = 10 marks)

Q12.

Feeding relationships can be shown using food chains.

This food chain comes from a woodland ecosystem.

oak tree → earthworm → vole → hawk

(a) Name the secondary consumer in this food chain.

(1)

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(b) (i) Draw a pyramid of numbers for this food chain.

Label your pyramid.

(3)

(ii) Describe how a pyramid of biomass would look different to a pyramid of numbers.

(2)

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(iii) Explain why the biomass changes moving up the pyramid.

(3)

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(Total for question = 9 marks)

Q13.

Feeding relationships can be shown using food chains.

This food chain comes from a woodland ecosystem.

oak tree → earthworm → vole → hawk

(a) Name the secondary consumer in this food chain.

(1)

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(b) (i) Draw a pyramid of numbers for this food chain.

Label your pyramid.

(3)

(ii) Describe how a pyramid of biomass would look different to a pyramid of numbers.

(2)

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(iii) Explain why the biomass changes moving up the pyramid.

(3)

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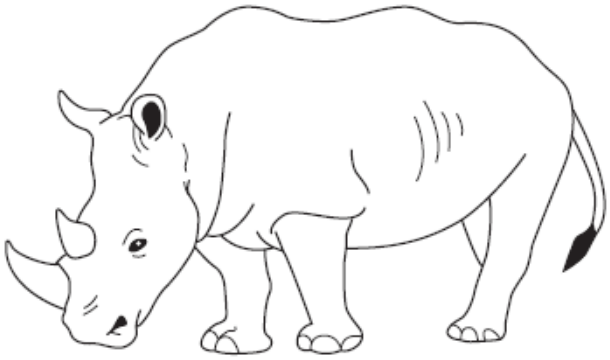
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(Total for question = 9 marks)

Q14.

A rhino is a large mammal that lives in hot parts of Africa.

The drawing shows a rhino.



(a) The rhino feeds on plants and rests in the shade during the day.

(i) Which of the following describes the trophic level of a rhino?

(1)

☒ **A** producer

☒ **B** primary consumer

☒ **C** secondary consumer

☒ **D** tertiary consumer

(ii) Which of the following explains why the rhino rests in the shade during the day?

(1)

☒ **A** it has a large surface area to volume ratio and needs to avoid overheating.

☒ **B** it has a large surface area to volume ratio and needs to gain heat.

☒ **C** it has a small surface area to volume ratio and needs to avoid overheating.

☒ **D** it has a small surface area to volume ratio and needs to gain heat.

(b) The horn of the rhino is valuable in some human cultures. This results in rhinos being killed just for their horn.

This species is at risk of extinction because the mean rate of killing is one rhino every six hours.

In 2016, there were an estimated 25000 of one species of rhino in Africa.

Calculate the year in which this rhino species would become extinct, assuming the number of births equals the number of natural deaths.

(3)

year = ...

(c) In an effort to protect the rhino from extinction, scientists have produced a heart rate monitor.

The monitor is attached to the rhino. It sends an alarm signal to the nearest police station if the rhino is under stress.

This allows the police to respond quickly to save the rhino from being killed.

(i) Explain how stress affects the heart rate of a rhino.

(2)

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(ii) Describe the evidence the scientists need to find out if this method helps to protect the rhino from extinction.

(2)

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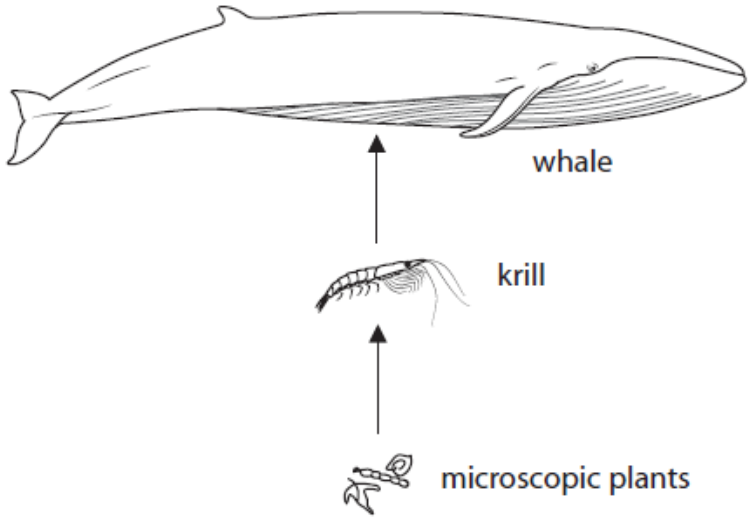
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(Total for question = 9 marks)

Q15.

The diagram shows a food chain in the Antarctic ocean.



(a) (i) Which term describes the trophic level of the krill?

(1)

☒ **A** predator

☒ **B** prey

☒ **C** primary consumer

☒ **D** secondary consumer

(ii) Draw a labelled pyramid of biomass to represent this food chain.

(2)

(b) The microscopic plants float in seawater, but also grow on the lower surface of ice.

The krill feed on the microscopic plants.

They remove microscopic plants from the lower surface of the ice at a rate of 1.6 cm^2 per second.

Calculate the time taken for the krill to remove microscopic plants from one square metre of ice.

Give your answer in minutes.

(2)

time taken = ... minutes

(c) A student investigates the rate that krill feeding removes microscopic plants floating in seawater.

Suggest how the student could do this investigation in a laboratory.

(4)

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(d) Krill obtain most of their food from microscopic plants growing on the lower surface of ice.

Explain how global warming could affect the whale population in the Antarctic ocean.

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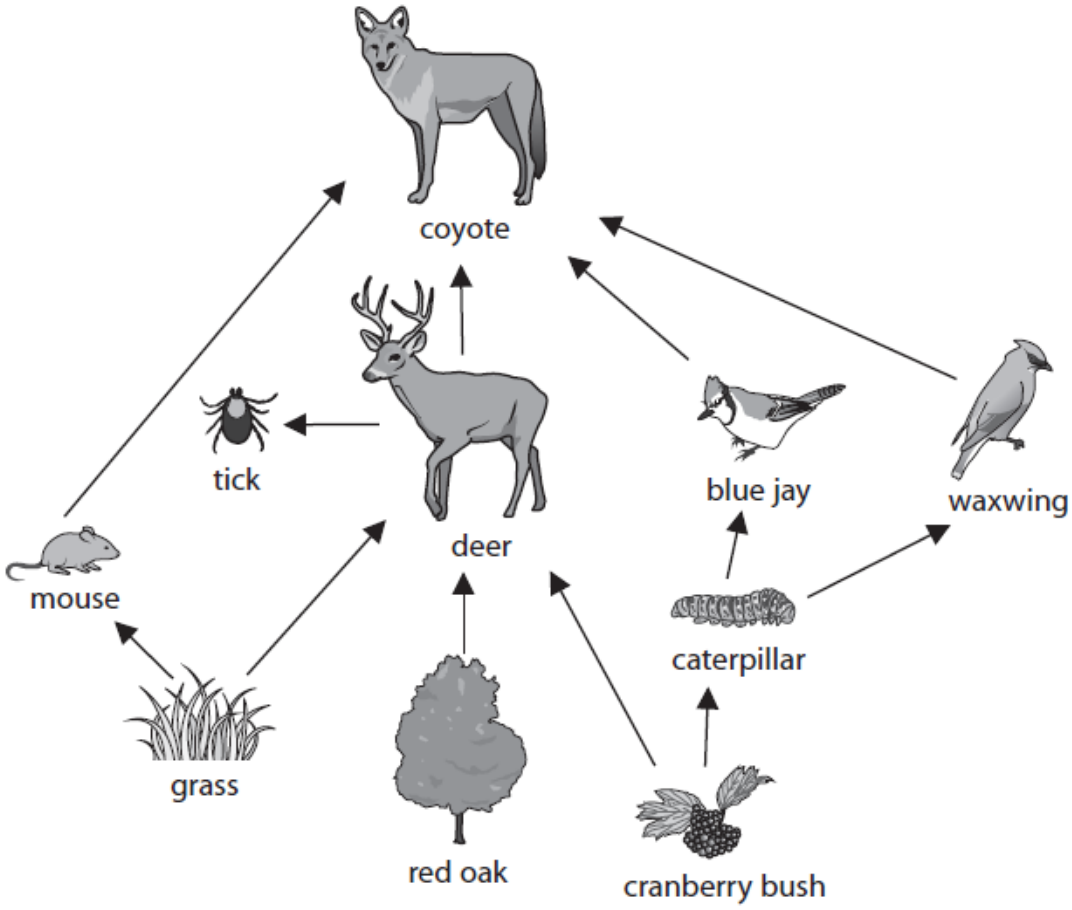
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(Total for question = 13 marks)

Q16.

The diagram shows a forest food web.



(a) (i) How many producers are shown in this food web?

(1)

☒ **A** one

☒ **B** three

☒ **C** four

☒ **D** nine

(ii) How many secondary consumers are shown in this food web?

(1)

☒ **A** one

☒ **B** three

☒ **C** four

☒ **D** seven

(b) The coyote uses some of its senses to catch deer.

(i) Name the sense that uses receptor cells in the retina.

(1)

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(ii) A coyote runs 530 metres in 30.0 seconds trying to catch a deer.

Calculate the speed of this coyote in metres per second.

(2)

speed = ... m/s

(c) The coyote will not catch the deer if too much lactic acid builds up in its muscles.

Explain why lactic acid builds up in the coyote's muscles when it runs.

(2)

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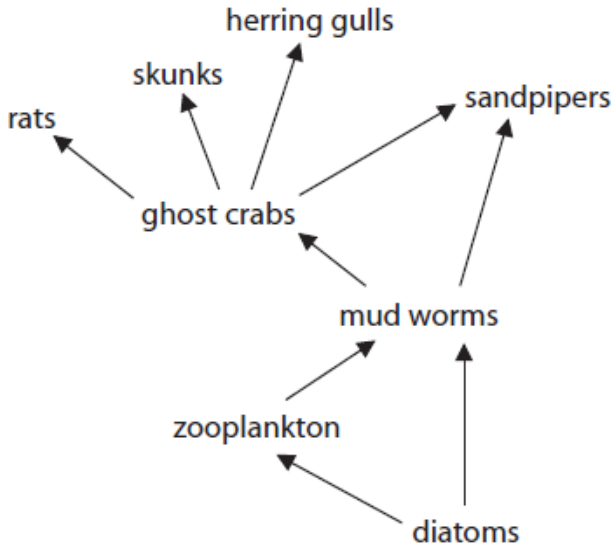
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(Total for question = 7 marks)

The diagram shows a food web.



(a) Use information from the food web to complete the table.

The first one has been done for you.

(3)

number of organisms	8
number of producers	
number of primary consumers	
number of food chains	

(b) Explain why the energy in the mud worms is not all transferred to the organisms that eat them.

(4)

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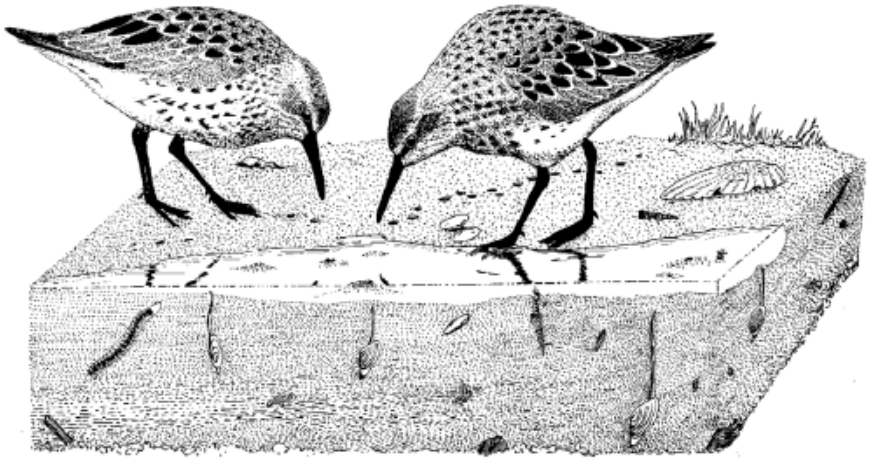
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(c) The diagram shows sandpipers feeding.

Sandpipers have long beaks so that they can dig for worms in the mud.



(Source: © Birchside www.fotosearch.com)

Explain how sandpipers evolved to have long beaks.

(4)

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(Total for question = 11 marks)

Faeces contain undigested food.

(a) The table shows the percentage of different substances in a dry sample of faeces.

Substance	Percentage in dry sample of faeces (%)
carbohydrate	30
fat	20
protein	3

(i) Name a carbohydrate that could be found in faeces.

(1)

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(ii) Describe how you would test the sample of faeces for fat.

(2)

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(iii) State the five chemical elements that could be present in protein.

(1)

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(b) Grass is eaten by many animals.

Diagram 1 shows a grass cell.

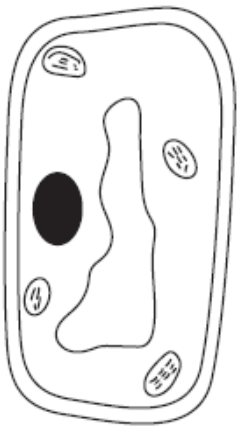


Diagram 1

Diagram 2 shows this grass cell in the faeces of an animal.

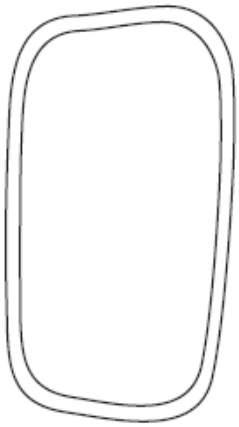


Diagram 2

Explain the difference in the appearance of these grass cells.

(3)

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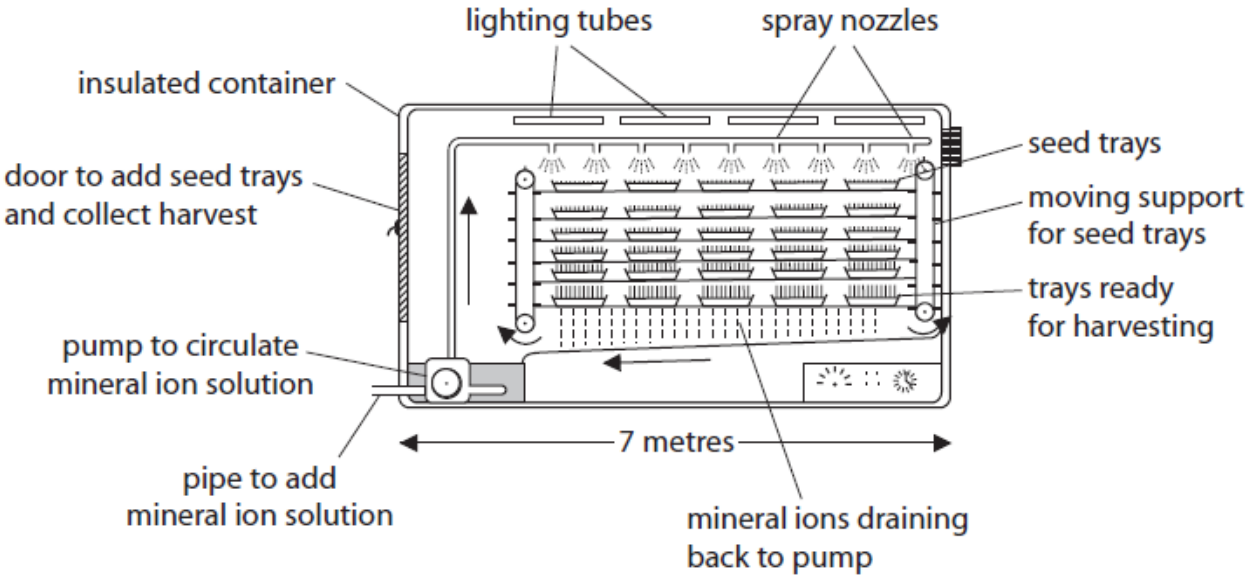
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(c) The diagram shows a section through a building that has been designed to grow grass indoors.



This is the method used to grow grass in the building.

- wash and sterilise empty trays
- fill these trays with soil containing grass seeds
- put these trays in the building
- spray mineral ion solution on to the soil in the trays
- provide light and keep the temperature at 20 °C
- collect the grass after a week and feed to animals

1000 kg of grass can be grown every day using this method.

A farmer would need to use several fields to grow this mass of grass every day outdoors.

The farmer decides to grow grass in the building to feed his animals, rather than letting them eat grass from his fields.

Discuss this decision.

(6)

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(Total for question = 13 marks)

Weeds are plants that compete with crop plants.

A scientist investigates the use of two different ways of reducing the population of weeds.

This is her method.

- use chemical control in one field by spraying herbicides, a type of pesticide, that kill the weeds
- use biological control in another field by releasing insects that eat the weeds
- measure the mean (average) number of weeds in each field once a month from February to August

The table shows the scientist's results.

Month	Mean number of weeds per m^2	
	chemical control	biological control
February	2	12
March	16	8
April	3	4
May	20	3
June	3	4
July	18	3
August	2	3

(a) Describe a method to measure the mean number of weeds per m^2 in each field.

(3)

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(b) The scientist concludes that biological control is a better way of controlling weeds than chemical control.

Discuss this conclusion.

Use data from the table and your own knowledge to support your answer.

(5)

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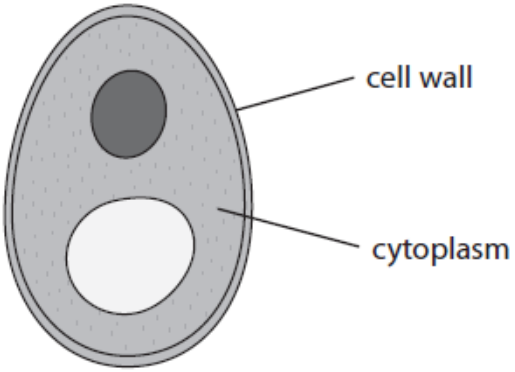
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(Total for question = 8 marks)

The diagram shows a yeast cell.



(a) (i) Which row of the table is correct for this yeast cell?

(1)

		Substance in cell wall	Substance stored in cytoplasm
☒	**A**	cellulose	glycogen
☒	**B**	cellulose	starch
☒	**C**	chitin	glycogen
☒	**D**	chitin	starch

(ii) Which type of organism is a yeast cell?

(1)

☒ **A** a bacterium

☒ **B** a fungus

☒ **C** a plant

☒ **D** a protoctist

(b) Biofuel is made from ethanol.

Scientists use genetically modified (GM) yeast to produce biofuel.

The GM yeast contains an enzyme that digests plant cell walls to produce glucose.

The yeast uses the glucose in respiration to produce ethanol.

(i) Which of these equations shows the respiration in the yeast?

(1)

☒ **A** glucose → ethanol

☒ **B** glucose → ethanol + carbon dioxide

☒ **C** glucose + oxygen → ethanol

☒ **D** glucose + oxygen → ethanol + carbon dioxide

(ii) Name an enzyme used by scientists to genetically modify the yeast.

(1)

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(iii) The GM yeast is a recombinant strain.

State what is meant by the term **recombinant**.

(1)

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(iv) Suggest why biofuel produced using glucose from plants could reduce global warming.

(2)

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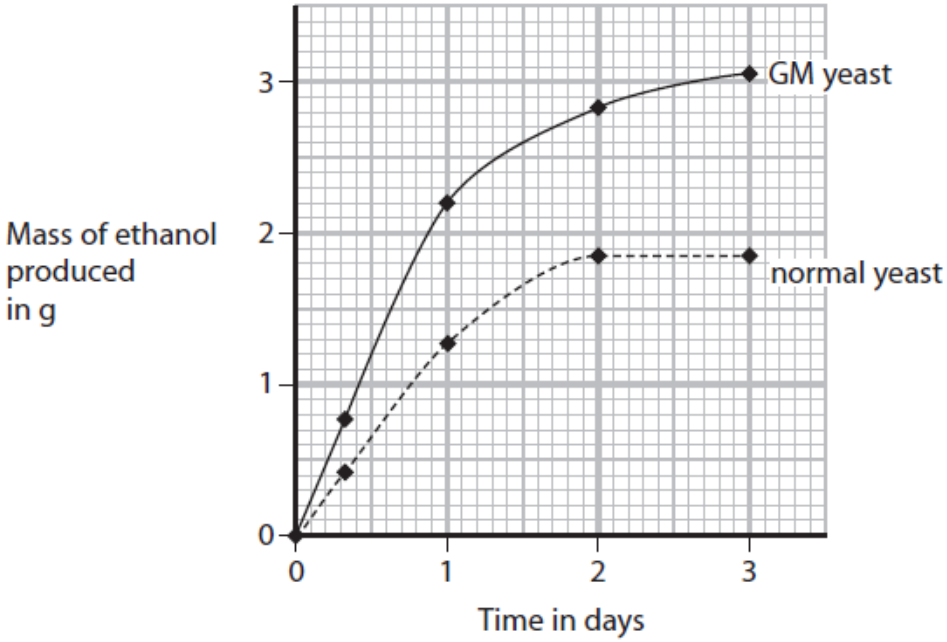
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(c) The graph shows the mass of ethanol produced by GM yeast and by normal yeast over a period of 3 days.



(i) Calculate the percentage increase in the mass of ethanol produced by GM yeast compared to normal yeast after
1 day.

(2)

percentage increase = ... %

(ii) Give two reasons why the rate of ethanol production decreases after 1 day.

(2)

1 .....

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2 .....

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(Total for question = 11 marks)